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PATHOGENCITY OF *SCLEROTIUM ROLFSII* ON DIFFERENT CROPS AND EFFECT OF INOCULUM DENSITY ON COLONIZATION OF MUNGBEAN AND SUNFLOWER ROOTS

FOUZIA YAQUB AND SALEEM SHAHZAD

Pest & Disease Research Lab., Department of Botany, University of Karachi, Karachi- 75270. Pakistan.

Abstract

Sclerotium rolfsii proved to be highly pathogenic on sunflower, mungbean and sugar beet, mildly pathogenic on tomato, lentil, sweet pumpkin and cabbage, and non-pathogenic on cauliflower plants in pot experiments. Increase in inoculum density of *S. rolfsii* caused gradual reduction in growth parameters of sunflower and mungbean plants whereas a positive correlation was observed between root colonization and population of *S. rolfsii* in soil.

Introduction

Sclerotium rolfsii Sacc., is a soil-borne pathogen that commonly occurs in the tropics, sub-tropics and other warm temperate regions of the world causing root rot, stem rot, wilt and foot rot on more than 500 plant species including almost all the agricultural and horticultural crops (Aycock, 1966; Domsch *et al.*, 1980; Farr *et al.*, 1989). An estimated loss of up to US$ 10-20 million because of *S. rolfsii* has been reported in southern peanut growing region of USA with yield depletion ranging from 1-60% in different fields (Aycock, 1966). Ahmed *et al.*, (1984) made the first report of *S. rolfsii* from Pakistan on maize *(Zea mays).* The fungus was subsequently reported from oat (*Avena sativa)* and mash bean *(Vigna mungo)* (Shahzad & Ghaffar, 1995), apple *(Malus sylvestris)* (Jahangir *et al.*, 1995), lentil *(Lens culinaris)* (lqbal *et al.*, 1995) and seeds of sugarbeet *(Beta vulgaris)* (Ruqia, 2001). Experiments were therefore carried out to study the pathogenecity of *S. rolfsii* on sunflower *(Helianthus annuus),* mungbean *(Vigna radiata),* sweet pumpkin *(Cucurbita pepo),* sugarbeet, tomato *(Lycopersicon esculentum),* lentil, cabbage *(Brassica oleracea* var. *capitata)* and cauliflower *(Brassica oleracea* var. *botrytis).* The effect of different inoculum densities of the pathogen on root colonization and growth of mungbean and sunflower plants was also evaluated.

Materials and Methods

Preparation of inoculum: Wheat straw was cut into 2-3 cm long pieces and soaked in water for 2 hrs. The straw was pressed between hands to remove excess moisture, transferred into 250 ml conical flasks and sterilized for 20 min at 15 psi. A 5 mm diam., inoculum disc from an actively growing culture of *S. rolfsii* (isolated from sugarbeet) on potato sucrose agar (PSA) was transferred into each flask. The flasks were incubated at room temperature for one month for production and maturation of sclerotia. The straw were then spread on a sterilized blotter paper sheet, allowed to air dry and sclerotia collected in sterile glass vials and stored in a refrigerator for future use. Viability of the sclerotia was assessed on PSA amended with Penicillin (@100,000 units L^{-1}) and Streptomycin (@ 0.2 g L^{-1}).

Pathogenecity of *S. rolfsii* on different plants: Sterilized soil was artificially infested with sclerotia of *S. rolfsii* @ 1 sclerotia g^{-1} soil and transferred into 8 cm diam., thermopole pots @ 150 g soil per pot. Sterilized soil not infested with *S. rolfsii* served as control. Seeds of sunflower, mungbean, sweet pumpkin, sugarbeet, lentil, tomato, cabbage and cauliflower were sown in separate sets @ 10 seeds per pot. Soil moisture was adjusted to 50% WHC (Keen & Raczkowski, 1921) and amount of water lost was restored after each 24 hrs. There were three replicates of each treatment and the pots were randomized on a screen house bench. Plants were uprooted after 30 days growth to assess colonization of roots by *S. rolfsii.* Fresh plant weight and length, and length of shoot were also recorded.

Isolation of S. *rolfsii* from root: Roots were washed in running tap water to remove soil particles. Seven randomly selected 1cm long root pieces from each plant were surface sterilized with 1% NaOCl solution for 5 min and transferred onto PSA plates containing Penicillin (@100,000 units L^{-1}) and Streptomycin (@ 0.2 g L^{-1}). After incubation for 5 days at room temperature, colonization of roots by *S. rolfsii* was recorded using the following formula:

$$\text{Colonization\%} = \frac{\text{Number of root pieces colonized by the pathogen}}{\text{Total number of root pieces}} \times 100$$

Data on root colonization were converted into roots colonization index (RCI) according to a 0-5 scale of Shahzad & Ghaffar (1992) where 0=0, l=l-10, 2=11-25, 3=26-50, 4=51-75 and 5=75-100% root pieces colonized by the pathogen.

Effect of different inoculum densities of *S. rolfsii*: In another experiment sterilized soils were artificially infested with *S. rolfsii* @ 0.1, 1, 5 and 10 sclerotia g^{-1} and transferred into 8 cm diam., thermopole pots @ 150 g per pot. Ten surfaced sterilized seeds of sunflower were sown in each pot. Seed sown in sterilized soil not infested with *S. rolfsii* served as control. In a comparable set, mungbean was used as a test plant. Soil moisture was adjusted to 50% WHC and amount of water lost was restored after each 24 hrs. There were three replicates of each treatment and the pots were randomized on a screen house bench. Data on plant growth and root colonization were recorded after 30 days growth using the method described above.

Results and Discussion

Pathogenecity of *S. rolfsii* on different plants: Soil infestation with *S. rolfsii* showed a significant reduction in germination of sunflower, mungbean and sugar beet seeds as compared to control. Germination of tomato, sweet pumpkin, cabbage and cauliflower seeds were slightly reduced. The highest reduction in plant length, weight and shoot weight as compared to control was observed in sunflower and mungbean followed by sugarbeet, tomato, sweet pumpkin and cabbage. Cauliflower plants showed no effect of *S. rolfsii* infection on plant growth (Fig. 1). Root colonization by *S. rolfsii* was observed in all test plants growing in artificially infested soil. However, sunflower, mungbean, tomato and sugarbeet showed greater RCI as compared to lentil, sweet pumpkin, cabbage and cauliflower plants (Fig. 2).

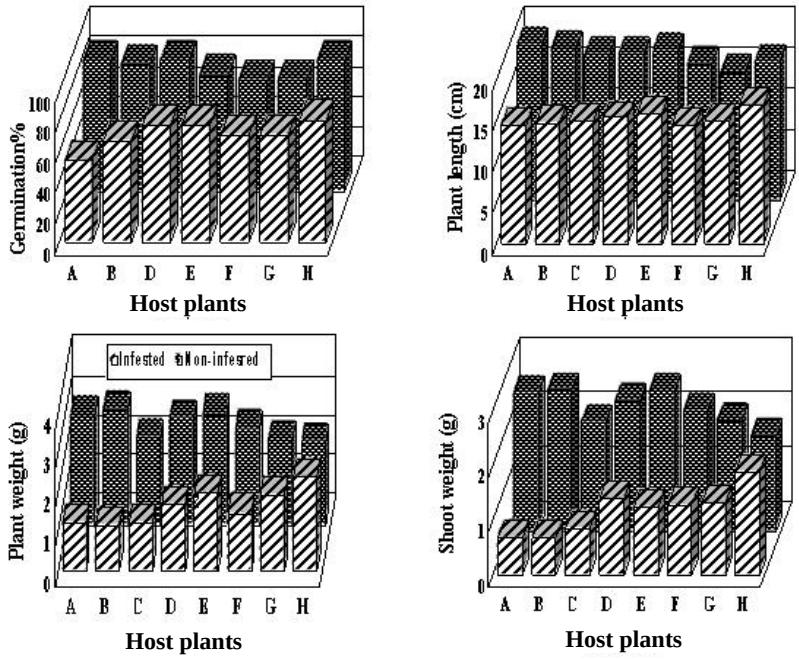

Fig. 1. Effect of *Sclerotium rolfsii* on growth of different test plants.

A= Sunflower, B= Mungbean, C= Sugarbeet, D= Tomato, E= Lentil, F= Sweet pumpkin, G= Cabbage, H= Cauliflower.

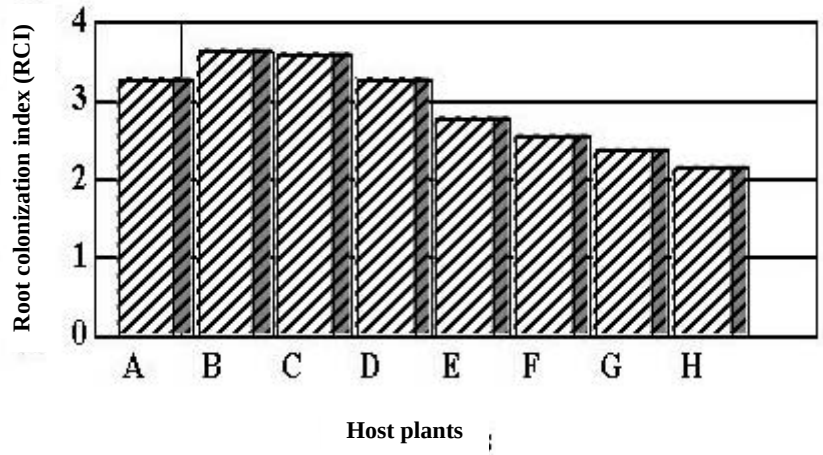

Fig. 2. Root colonization by *Sclerotium rolfsii* on different test plants in soil artificially infested with *S. rolfsii* @ 1 sclertium g^{-1} soil.

A= Sunflower, B= Mungbean, C= Sugarbeet, D= Tomato, E= Lentil, F= Sweet pumpkin, G= Cabbage, H= Cauliflower.

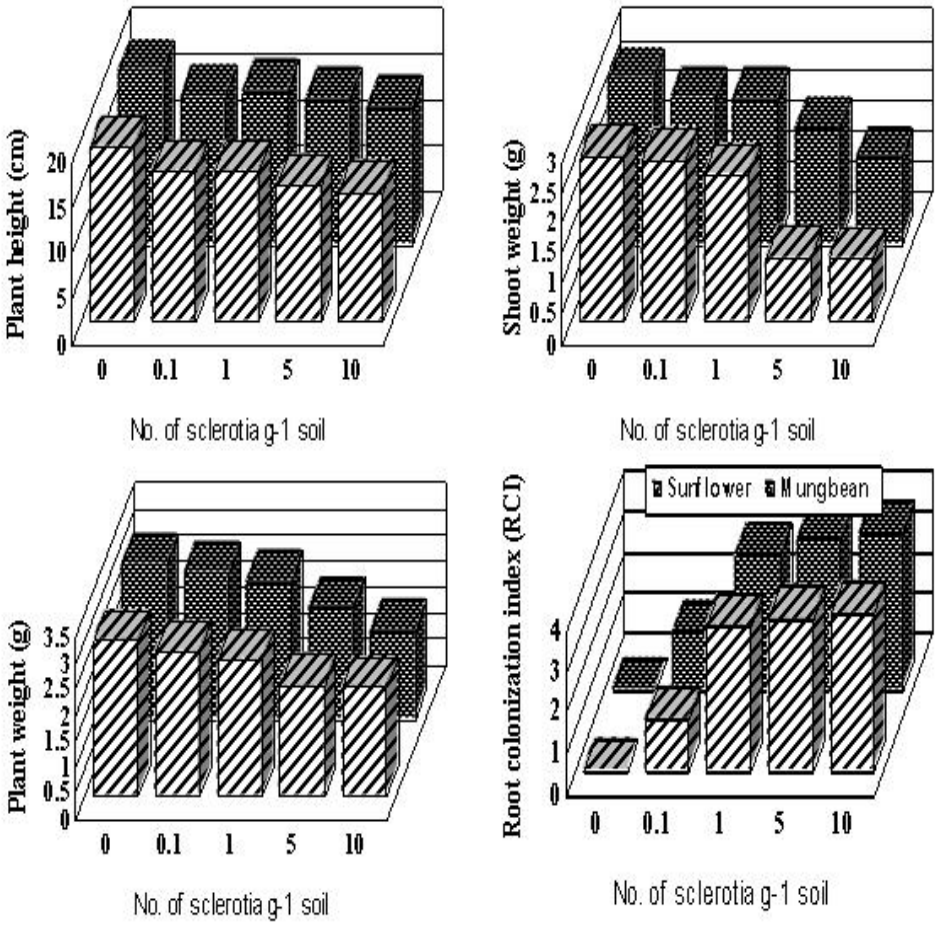

Fig. 3. Effect of different population levels of *Sclerotium rolfsii* on plant growth and root colonization of mungbean and sunflower.

Shokes & Gorbet (1998) observed that *S. rolfsii* produced stem and pod rot on ground nut with potential death and estimated field yield losses of 10% or more in the southern-eastern USA where pods yield were significantly and negatively correlated with disease incidence. Similarly, Blum & Rodriguez (2004) also recorded reduction in seed germination and plant growth in soybean that was, however, improved by organic soil amendments. Likewise, Khalequzzaman (2003) recorded a reduction in length of shoot and root, fresh weight of shoot and root with nodules, number of pods, number of nodules and yield in soybean plants inoculated with *S. rolfsii* and *Meloidogyne javanica* as compared to uninoculated plants. Such similar results on the pathogenecity of *S. rolfsii* have also been reported on *Edgeworthia papyrifera* from Taiwan (Chang, 1994), maize and apple from Pakistan (Ahmed *et al.*, 1984; Jahangir *et al.*, 1995), *Phaius flavus* and *Paphiopedilum venustum* from India (Bag, 2004), chilli from Malaysia (Jomduang, 1995) and apple from USA (Conway & Tomasino, 1985).

Effect of different inoculum densities of *S. rolfsii*: A negative correlation between the inoculum level of *S. rolfsii* in soil and plant growth parameters was observed since plant length and weight and shoot weight in both the host plants decreased gradually with increase in population of *S. rolfsii* in soil (Fig. 3). RCI showed a positive correlation with the population of *S. rolfsii* and an increment in inoculum level of the pathogen in soil resulted in an increase in root colonization (Fig. 3). Correlation between plant growth parameters and RCI was negative. It was interesting to note that there was no significant difference in RCI in treatments containing 1, 5 and 10 sclerotia g^{-1} soil.

The results of the present study corroborate well with the report made by Khalequzzaman (2003) where soybean plants inoculated with different inoculum levels of *S. rolfsii* and *M. javanica*, showed a gradual reduction in plant growth, nodulation and yield per plant with a gradual increase in inoculum levels. Chang (1994) also evaluated the effect of inoculum density on disease incidence of *Sclerotium* rot of *Edgeworthia papyrifera* by using four inoculum levels viz., 8, 4, 2 and 1 sclerotium per seedling, and reported that time for causing plants death was reversely in proportion to number of sclerotia inoculated. To reduce the incidence of *S. rolfsii* on carrot, Punja (1986) suggested that fields containing an average inoculum density of one or more viable sclerotia/300cm^3 should be avoided. Jomduang (1995) reported that high concentration of *S. rolfsii* propagules was needed to cause foot rot disease in the older chilli plants.

References

Ahmed, Y., M.S. Mirza and M. Aslam. 1984. *Sclerotium rolfsii* on maize. *FAO Plant Prot. Bull.*, 32: 147.

Aycock, R. 1966. Stem rot and other diseases caused by *Sclerotium rolfsii. NC. Agric. Exp. Sta. Tech. Bull, No.* 174. 202pp.

Bag, T.K. 2004. Two new orchid hosts of *Sclerotium rolfsii* from India. *Plant Pathol.*, 53: 255.

Blum, L.E.B. and R. Rodriguez-Kabana. 2004. Effect of organic amendments on sclerotial germination, mycelial growth, and *Sclerotium rolfsii* induced diseases. *Fitopatologia Brasileira*, 29: 66-74.

Chang, T. 1994. Pathogenicity of *Sclerotium rolfsii* on *Edgeworthia papyrifera* and sclerotial survival. *Bull Taiwan For. Res. Inst. New Series.* 9: 191-196.

Conway, K.E. and S.F. Tomasino. 1985. *Sclerotium rolfsii*, a problem to apple nursery stock in Oklahoma. *Phytopathol.*, 75: 499.

Domsch. K.H., W. Gams and T.H. Anderson. 1980. *Compendium of Soil Fungi.* Academic Press, London, NewYork.

Farr, D.F., G.F. Bills, G.P. Chamuris and A.Y. Rossman. 1989. *Fungi on plant and plant products in the United States.* American Phytophythological Society, St. Paul.

Iqbal, S.M., A. Bakhsh, S. Hussain and B.A. Malik. 1995. Microbial antagonism against *Sclerotium rolfsii*, the cause of collar rot of lentil. *Lens-Newsletter*, 22: 48-49.

Jahangir, A.M., M.K. Mohibullah, M. Ayub and M. Khan. 1995. Detection of fungi causing root rot of apple nurseries in Swat. *Sarhad J. Agri.*, 11: 754-748.

Jomduang, J. 1995. *Evaluation of Malaysian isolates of Trichoderma harzianum and Gliocladium virens for the biological control of Sclerotium foot rot of chilli*. Thesis Dissertation, Department of Plant Protection, Universiti Putra Malaysia. 175pp.

Keen, B.A. and H. Raczkowski. 1921. The relation between clay content and certain physical properties of soil. *J. Agric. Sci*., 11: 441-449.

Khalequzzaman, K.M. 2003. Effect of inocula levels of *Meloidogyne javanica* and *Sclerotium rolfsii* on the plant growth, yield and galling incidence of soybean. *Pak. J. Pl. Pathol.*, 2: 56-64.

Punja, Z.K. 1986. Progression of root rot on processing carrots due to *Sclerotium rolfsii* and the relationship of disease incidence to inoculum density. *Can. J. Plant Path*., 8: 297-304.

Ruqia, B. 2001. *Studies on seed-borne mycoflora of sugarbeet (Beta vulgaris).* M.Sc. Thesis, Department of Botany, University of Karachi, Karachi. 30 pp.

Shahzad, S. and A. Ghaffar. 1992. Root rot and root knot disease complex of mungbean and its biological control. pp. 349-256. In: *Status of Plant Pathology in Pakistan. Proc. National Symp*., (Eds.) A. GhafFar & S. Shahzad. Department of Botany, University of Karachi, Karachi-75270, Pakistan.

Shahzad, S. and A. Ghaffar. 1995. New records of soilborne root infecting fungi in Pakistan. *Pak. J. Bot.*, 17: 209-216.

Shokes, F. and D. Gorbet. 1998. Crop losses due to stem rot of groundnut in commercial cultivars and partially resistant breeding lines. *ICPP98* Paper No. 3.4.5.

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